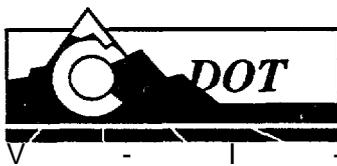




**CORRIDOR PLANNING
AND FEASIBILITY ANALYSIS**

**EARLY ACTION PROJECTS
EXECUTIVE SUMMARY**



COLORADO DEPARTMENT OF TRANSPORTATION

**Colorado Department
of Transportation**

DE LEUW, CATHER & COMPANY

Engineers and Planners • Denver

in association with

Kaman Sciences Corporation • Coley/Forrest, Inc.

University of Colorado at Denver

660205-01330

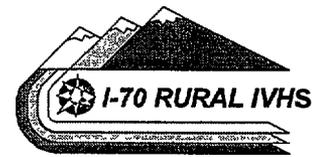
**July 1994
Revised: October 1995**





TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	ES-1
PURPOSE	ES-1
PROCESS	ES-1
Table ES-1: Top 15 Early Action Projects/Implementation Goals Matrix	ES-3
RECOMMENDED EARLY ACTION PROJECTS	ES-4
Figure ES-1: Early Action Project Locations	ES-5
Voice/Data Communications Upgrades	ES-6
Vail Super-HARNMS Program	ES-9
Dumont/Downieville Automated Port of Entry	ES-12
Hot Spot Courtesy Patrols	ES-16
High-Capacity Data Transmission Links	ES-20
Summit Stage Transfer Center APTS/ATIS Operational Test	ES-23
Incident Investigation Sites	ES-27
Automated Reversible Lane Program	ES-30
Corridor-Wide Call Box System	ES-33
Mobile Emissions Testing Stations	ES-35
Advanced Technology Roadway Delineation	ES-39
Hanging Lake TOC Upgrades	ES-41
Emergency Response Information System	ES-44
Advanced Ice Detection/Warning System	ES-46
Georgetown Gusty Wind Sensor/VMS System	ES-48



INTRODUCTION

The early action item task documentation for the *I-70 Rural M-IS Corridor Planning and Feasibility Analysis* (I-70 Rural IVHS) study has been divided into two reports. The **Early Action Projects Executive Summary** serves as a guidance document for initiating and deploying 15 top priority Intelligent Transportation System (ITS) Early Action Projects identified as integral to resolving a critical problem and/or addressing a high-priority transportation need within the I-70 West Corridor from Denver to Glenwood Springs. The companion document, **Early Action Projects Appendix**, details the background and process used to identify the top 15 Early Action Projects from a global project set.

One of the elements scoped in the contract for the *I-70 Rural IVHS* study requires that early action items be identified and detailed prior to completion of the Corridor Master Plan. This **Early Action Projects Executive Summary** describes those projects. It provides a preview of the types of ITS actions that will be considered and recommended for short- (5 to 10 years), medium- (10 to 25 years), and long-term (beyond 25 years) implementation in the Corridor Master Plan.

PURPOSE

The **Early Action Project Executive Summary** is intended to guide the Colorado Department of Transportation (CDOT) and its potential public and private partners in developing and deploying, within the next five years, 15 pivotal advanced technology applications to address predominant transportation problems and needs within the I-70 West Corridor from Denver to Glenwood Springs. These projects are strongly recommended for funding in the Department's 1995 to 1999, 5-year capital improvement plan and for incorporation in the Statewide Transportation Improvement Program (STIP).

The lower ranking of other Early Action Projects (those below the top 15), described in the **Early Action Projects Appendix**, does not mean that they will not be implemented. These projects may be identified in the Corridor Master Plan for short-, medium-, or long-term deployment; they may be deployed independently of this study for reasons that were not considered as a part of the early action evaluation; or they may be reassessed in the near future (based on changing requirements or re-identified needs) and scheduled for funding in a subsequent year's capital improvement plan.

PROCESS

A corridor-wide agency outreach program was conducted to identify problems and needs associated with travel along the I-70 West Corridor from Denver to Glenwood Springs. Based on the input received, 80 potential projects were identified that could address each problem/need either individually or as a group. Each problem was described and evaluated for its resolution to the problem, its user benefit, and its approximate cost. Agencies that would participate in the development and deployment of each project were identified.

The agency input to the outreach program, in conjunction with the established goals and objectives for the study, was used to prioritize the suggested projects. The top 15 Early Action Projects were selected through a subjective ranking process based on 9 implementation goals developed by the I-70 Rural IVHS Study Steering Committee as important to meet the goals and objectives established for the study.



Those goals are:

- Enhance Traveler Mobility
- Increase Safety
- Improve Environmental Quality
- Augment Communications/User Interface
- Gain High Public/Political Acceptance
- Promote Transit Usage/Improve Transit Service
- Encourage Public/Private Sector Investment
- Use Advanced Technologies Innovatively
- Reinforce Economic Benefit

Table ES-1 maps the top 15 Early Action Projects (EAP) to each goal that they may satisfy. Although some projects may satisfy more implementation goals than others, quantity is less important than the quality of the match. For example, the top-ranked EAP, CS-4, Voice/Data Communications Upgrades is mapped to two goals (Communications/User Interface and Economic Benefit) while the second-ranked EAP, TIS-5, Vail Super-HAR/VMS Program satisfies 8 of the goals (Mobility, Safety, Communications/User Interface, Public/Political Acceptance, Transit Usage/Service, Public/Private Investment, Advanced Technologies, and Economic Benefit). Because ITS applications are data intensive, the impact of EAP CS-4 is far greater toward deploying all future advanced technology systems corridor-wide than the site specific benefit derived from EAP TIS-5. Reliable and responsive voice and data communications capabilities **must** be established at collection, processing, and dissemination sites to ensure accurate and timely information.

As noted above, the ranking process was subjective, resulting in a “rough” assignment of the most important projects recommended for deployment within the next 5 years. Each of the 15 projects have an enormous potential to benefit the users whom they are identified to serve. They each reflect a solution to a recurrent problem or essential need. Most will achieve significant public approval. All will provide a piece of the necessary foundation for future ITS applications within the I-70 West Corridor.

The Early Action Projects documentation was revised in 1995 to incorporate other statewide ITS planning and programming initiatives, specifically, the Executive Summary and Appendix integrate the efforts by the CDOT ITS Program Office to coordinate **the Denver Metro Area Early Deployment Study, the Smart Path Strategic and Business Plans, the Colorado Traffic Operations Center (C-TUC) initiatives, the 20-Year Transportation Plan,** and the original vision of the **C-Star Strategic Plan for Intelligent Vehicle-Highway Systems in Colorado** with the I-70 West Corridor recommendations to ensure consistency and accuracy of projects, funding, and schedules.

**TABLE ES-1
TOP 15 EARLY ACTION PROJECTS / IMPLEMENTATION GOALS MATRIX**

EARLY ACTION PROJECT									
	MOBILITY	SAFETY	ENVIRONMENTAL QUALITY	COMMUNICATIONS/USER INTERFACE	PUBLIC POLITICAL ACCEPTANCE	TRANSIT USAGE SERVICE	PUBLIC PRIVATE INVESTMENT	ADVANCED TECHNOLOGIES	ECONOMIC BENEFIT
cs-4 Voice/Data Communications Upgrades				X					X
TIS-5 Vail Super-HAR/VMS Program	X	X		X	X	X	X	X	X
cvo-2 Dumont/Downieville Automated Port of Entry	X	X	X	X	X			X	X
ER-1 Hot Spot Courtesy Patrols	X	X	X	X	X		X		X
cs-2 High-Capacity Data Transmission Links				X			X	X	X
PTAM-1 Summit Stage Transfer Center APTS/ ATIS Operational Test	X	X	X	X	X	X	X	X	X
SW-1 Incident Investigation Sites	X	X		X	X				X
TMO-3 Automated Reversible Lane Program	X			X	X				X
ER-3 Corridor-Wide Call Box System		X			X		X		X
EEI-5 Mobile Emissions Testing Stations			X		X	X	X		X
SW-4 Advanced Technology Roadway Delineation		X			X			X	X
cs-9 Hanging Luke TOC Upgrades				X				X	
SW-8 Emergency Response Information System		X			X			X	
DCA-7 Advanced Ice Detection Warning System	X	X	X		X			X	
TIS-1 Georgetown Gusty Wind Sensor/VMS System		X		X	X			X	X





RECOMMENDED EARLY ACTION PROJECTS

Using the initial Early Action Project descriptions as a nucleus (see Early Action Projects Appendix), each of the top 15 projects were identified and evaluated further to provide additional detail on cost, responsibility, implementation schedule, and rationale for why each should be deployed in the near future. The following detailed project descriptions include:

The Project Identification uses an acronym for the functional area/review group category followed by an ordered number representing the total number of the projects in that group. There is no significance to the order or ranking of projects by number.

The Project **Name** identifies the early action application by an abbreviated descriptive title so that project intent can be readily recognized for its function.

The Project Description provides a brief discussion of location, advanced technologies to be used, and the overall structure of the proposed system.

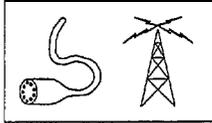
Problem Resolution defines the transportation problems or needs that the project can alleviate or solve.

User Benefit identifies the potential benefits of the proposed project and who the benefactors are.

Project Rationale indicates why the project should be initiated immediately and implemented within the next 5 years.

Participating Partners/Responsibilities lists those organizations that should cooperate in the deployment of the project and identifies each partner's role and responsibility for planning, financing, designing, building, operating, and maintaining the project.

Preliminary Cost Estimate defines, in broad terms, the labor, material, construction, operation, and maintenance costs of project components. Training costs have not been addressed as they are expected to be funded through the operating agency's annual labor budgets.

**PROJECT IDENTIFICATION:**

cs-4

PROJECT NAME:

Voice/Data Communications Upgrades

PROJECT DESCRIPTION:

The telephone equipment and land line technology utilized for voice and data communications between CDOT and the Colorado State Patrol (CSP) facilities within the I-70 West Corridor is obsolete. The bandwidth limitations of copper twisted pair (TWP) communications media make transmission unstable, time consuming, and many times, inaccessible. Reliable communications between operations centers need to be established by installation of new or upgrade of existing communications media and transmission equipment. Ideally, a fiber optic network, or other high capacity media, will eventually be installed to handle all I-70 West Corridor needs. As an interim architecture for voice/data transmission, copper TWP can be used as a distribution cable to connect these facility data devices (modems, facsimiles) and voice circuits with each other and regional operations centers. As an alternate to TWP installation or upgrade, the state's existing microwave radio system can transmit voice and data to the remote sites where a point-to-point line of site can be achieved.

At each location, equipment for data and voice transmission should include, at a minimum, a telephone, a 14.4 kbps modem, and a plain paper facsimile dedicated to ITS applications.

Recommended site installations for this project include:

- The Eisenhower Tunnel traffic operations center (TOC) [CDOT Region 1 jurisdiction]
- A Road Control/County Field Office [CDOT Region 1 jurisdiction]
- The Vail Pass Rest Area [CDOT Region 1 jurisdiction]
- A new regional communications facility for the CSP at the Hanging Lake TOC

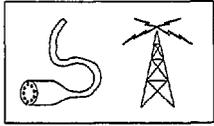
Recommended communications links for this project include:

- Between each of these new or upgraded sites;
- From each new or upgraded site to CDOT Region 1 and Region 3 headquarters;
- From each new or upgraded site to the Denver Interim TOC; and
- From each new or upgraded site to the CSP regional communications center in Eagle.

[Note: Additional sites and links, beyond those recommended, can be included at the discretion of the participating agencies.]

PROBLEM RESOLUTION:

- Existing voice/data communications are unreliable and inadequate.
- Existing land lines/equipment are old and dysfunctional.

**PROJECT IDENTIFICATION:**

cs-4

PROJECT NAME:

Voice/Data Communications Upgrades

USER BENEFIT:

- Efficient and effective communications.
- Enhanced data sharing.
- Labor savings through increased efficiency.
- Reduced personnel stress levels and improved attitude.

PROJECT RATIONALE:

ITS applications are data-intensive, requiring transmission capabilities that ensure accurate system function and reliability. Because of the high cost to install new high-capacity communications systems (fiber/microwave), this interim measure to upgrade communications equipment (telephone, modem, facsimile) and existing links (TWP, microwave channels) offers an immediate, cost-effective solution to voice and data communications until CDOT and/or potential private partners initiate fiber optic links or the Division of Telecommunications can afford installation of additional microwave relay towers or reflectors.

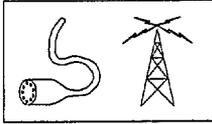
CDOT and CSP must have adequate communications equipment at their respective operational sites within the I-70 West Corridor and reliable communications links to share information between these sites and their respective regional headquarters. This interim solution will enable the agencies to accommodate existing and near-term voice and data transmission requirements for current communications needs, as well as for the communication requirements of the other Early Action Projects and future ITS initiatives.

PARTICIPATING PARTNERS/RESPONSIBILITIES:**Colorado Department of Transportation:**

Region I: Planning, design, and construction for primary upgrade sites (3) at Eisenhower Tunnel, Vail Pass Rest Area, and Field Office; regional links (6) between these sites and Region 1 headquarters; shared links from upgrade sites to Region 3 headquarters (3) and Hanging Lake tunnel (3), C-TOC (3), and CSP (3) sites. Operation and maintenance of upgrade sites and shared links.

Region 3: Planning, design, and construction for shared links between Region 3 headquarters and Hanging Lake tunnel operations with primary upgrade (6) and CSP (2) sites. Operation and maintenance of shared links.

Staff Traffic/ITS Program Office: Project management; planning, design, and construction for shared links between Denver Interim TOC and primary upgrade (3) and CSP (1) sites. Operator training.



PROJECT IDENTIFICATION:

cs-4

PROJECT NAME:

Voice/Data Conununications Upgrades

PARTICIPATING PARTNERS/RESPONSIBILITIES (Continued):

Colorado Division of Public Safety: Planning, design, and construction for primary upgrade site at Hanging Lake Tunnel (1); shared links (7) to CDOT primary upgrade sites, Region 1 and 3 headquarters, Eagle regional communications center, and Denver Interim TOC. Operation and maintenance of primary upgrade site, link to Eagle regional center, and other shared links.

Colorado Division of Telecommunications: Planning, design, implementation, operation, and maintenance for microwave links.

PRELIMINARY COST ESTIMATE:

Number of Sites/Links: 4/26

Management:	\$15,000 Per Year
Planning:	\$25,000
Design:	\$50,000
Equipment/Implementation:	
Voice/Data Equipment:	\$5,000 - \$10,000 Per Site
TWP Materials/Construction:	\$10,000 - \$40,000 Per Link
Additional Microwave Channels:	\$5,000 Per Channel
Operations/Maintenance:	\$10,000 Per Site Annually

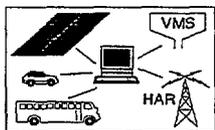
Project Total (For Sites/Links Noted, Excluding Operations/Maintenance): \$375,000 - \$1,225,000

Approximate Cost-Sharing Arrangement:

Colorado Department of Transportation:	\$310,000 - \$985,000
Region 1:	\$175,000 - \$650,000
Region 3:	\$70,000 - \$210,000
Staff Traffic/TTS Program Office:	\$65,000 - \$125,000
Colorado Division of Public Safety:	\$60,000 - \$185,000
Colorado Division of Telecommunications:	\$5,000 - \$55,000

IMPLEMENTATION PLAN:

Project Initiation:	June 1996
Project Management/Administration:	June 1996 - June 1997
Planning/Design:	February 1996 - December 1996
Construction/Implementation:	January 1997 - December 1997



PROJECT IDENTIFICATION:

TIS-5

PROJECT NAME:

Vail Super-HAR/VMS Program

PROJECT DESCRIPTION:

Interstate 70 (I-70) serves all vehicular traffic access to the Vail area. Heavy peak volumes create backups on I-70 and the local streets as recreationalists and tourists vie for prime parking at the east and west ends of town. Inadequate knowledge of open parking locations and accessible public transportation service, unfamiliarity with the access points to available services, and interference with high pedestrian traffic are coupled with the heavy vehicular traffic, creating a congested and poorly operating travel environment. The situation lends to frustration for visitors and residents alike and contributes to poorer air quality and denigration of the historical and captivating appeal of the area.

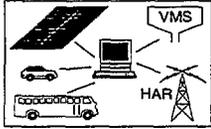
The Vail Super-HAR/VMS system would provide readily accessible, accurate, and up-to-date information on local parking lot capacity, traffic, and bus service that would be continually monitored and transmitted to assist travelers in making more informed access and circulation decisions. The system would include broadcasts via radio and roadside variable message signs (VMS) to advise approaching motorists of prevailing conditions and to guide them to the least congested access options.

Initially, some portions of the system functions would be performed manually, eventuating in a phased conversion of the major components to a fully-automated process. Real-time parking and bus schedule data would be collected manually by parking lot attendants and bus drivers and transmitted to a traffic management center via cellular telephone and/or two-way radio. The trained traffic management center operator would interpret and enter the data into a computerized system that, in turn, would select appropriate messages for broadcast over the highway advisory radio (HAR) channel and for transmission to the VMS.

A second phase of the program would involve deployment of automated sensor and communications subsystems to collect and transmit parking availability data electronically to the centralized computer system. Automation of the system will eliminate the need for manual counts, call-ins, and input to the system. Real-time parking data collection could be automated using a counter at each entrance/exit (\$600), and a modem to send the data back to the central processor (\$200). At \$800 per lot (not including the cost of a leased line), this would be less expensive than manually counting and calling in the information and could save approximately \$45,000 from the existing budget.

The HAR transmitter could be positioned on top of the Vail ski resort gondola tower or other high point to provide wide area transmission coverage. It would transmit on AM frequency 530. Messages broadcast over the HAR would be updated as new information is received through the computerized system. The initial VMS would be located on I-70 along the westbound approach to the Vail area, to provide parking information and advise motorists to tune into AM 530 for up-to-the-minute traffic/parking/bus reports and other travel messages. The VMS would become a part of the existing Dowd Junction sensor/VMS system and the future Tenmile Canyon/Vail Pass sensor/VMS system. Fixed (static) information signs, placed at strategic locations within the town limits.

A third program phase would equip buses with automatic vehicle location (AVL) devices to track exact vehicle position and movement. That data would be sent to the computer system for processing and transmission to computerized information centers located at bus stop kiosks, information centers (such as the facility at Lionshead), the ski area, and other appropriate locations throughout the Town of Vail. Ultimately, the advanced traveler information and public transportation management systems would be linked to other systems to provide an integrated corridor-wide network.



PROJECT IDENTIFICATION:

TIS-5

PROJECT NAME:

Vail Super-HAR/VMS Program

Funding to implement, operate, and maintain this system will rely, in a large part, on private sector participation, particularly by local business sponsorship of messages. It will be extremely important to initiate a FCC Rule-Making Permit process to allow sponsors to “advertise” in return for their dollar investment in the system.

PROBLEM RESOLUTION:

- High demand on Vail area parking facilities.
- Inadequate traveler knowledge of traffic access points and parking availability.
- Poor traffic circulation along I-70 and the local street network.

USER BENEFIT:

- Improved traffic operations.
- Better informed travelers.
- Greater utilization of parking facilities, resulting in increased revenues.
- More effective use of local, regional, and state resources.

PROJECT RATIONALE:

The Vail area attracts millions of visitors annually, stimulating not only the local economy, but tourism for the State of Colorado. The traffic congestion in this area creates a tremendous burden on I-70 operations and maintenance. Inadequate traveler information is one of the biggest culprits in creating the traffic problems along I-70 as well as along the local street network. This relatively low-cost system has great potential to relieve the symptomatic and recurrent congestion and to gain high public acceptance. It will also improve traffic conditions for the local residents and businesses so that quality of life is not compromised. This project will provide a base system in the Vail Valley area for receiving and transmitting other travel advisory information as other advanced technology systems are deployed throughout the I-70 West Corridor. It creates a cooperative relationship between CDOT and the Town of Vail and will stimulate private sector investment.

PARTICIPATING PARTNERS/RESPONSIBILITIES:

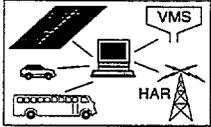
Colorado Department of Transportation:

Region 3: Project management, planning, design, and construction. HAR and VMS operations and maintenance.

Business Development: FCC Rule-Making Permit processing; private partner development.

Town of Vail: Input to planning and design; cost-sharing for system design consultant and equipment procurement; computer and transit systems operations and maintenance.

Local Sponsors: Financial investment in return for advertising on system.



PROJECT IDENTIFICATION:

TIS-5

PROJECT NAME:

Vail Super-HAR/VMS Program

PRELIMINARY COST ESTIMATE:

Management:	\$50,000
Planning (FCC Rule-Making/Partnerships):	\$25,000
Design:	
Software Development (Phase I):	\$50,000
Software Development (Phases II & III):	\$75,000
Equipment/Implementation:	
Cell Phones/Two-Way Radios (10):	\$10,000
Parking Lot Sensor System (3 lots):	\$5,000
AVL Sensor Systems for Transit (20 buses):	\$200,000
HAR System:	\$10,000
VMS System:	\$200,000
Communications Links:	\$5,000
Computer Processor System:	\$10,000
Computerized Information Kiosks (4 sites):	
Evaluation:	\$25,000
Operations/Maintenance (Includes Part-Time System Operator):	\$30,000 Annually
Project Total (Excluding Operations/Maintenance):	\$715,000

Approximate Cost-Sharing Arrangement:

Colorado Department of Transportation:	\$175,000
<i>Region 3 (Management, Design, Evaluation):</i>	<i>\$150,000</i>
<i>Business Development (Planning):</i>	<i>\$25,000</i>

Town of Vail:

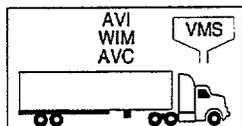
<i>Planning, Design, Evaluation, Procurement:</i>	<i>\$175,000</i>
<i>Operations/Maintenance:</i>	<i>\$10,000 - \$15,000 Annually</i>

Private Partners (Local Sponsors):

<i>Equipment Procurement, Construction:</i>	<i>\$365,000</i>
<i>Sponsorship:</i>	<i>\$15,000 - \$20,000 Annually</i>

IMPLEMENTATION PLAN:

FCC Rule Making/Private Partner Development:	January 1996 - June 1996
Hardware Specification/Procurement/Installation (Phase I):	June 1996 - December 1996
Software Design/Testing (Phase I):	October 1996 - February 1997
Evaluation (Phase I):	March 1997 - April 1997
Hardware Specification/Procurement/Installation (Phase II):	February 1997 - June 1997
Software Design/Testing (Phase II):	May 1997 - November 1997
Evaluation (Phase II):	December 1997 - January 1998
Hardware Specification/Procurement/Installation (Phase III):	November 1997 - June 1998
Software Design/Testing (Phase III):	July 1998 - August 1998
Evaluation (Phase III):	September 1998 - December 1998

**PROJECT IDENTIFICATION:**

cvo-2

PROJECT NAME:

Dumont/Downieville Automated Port of Entry

PROJECT DESCRIPTION:

Automating the Dumont/Downieville Port of Entry (POE), located along I-70 between Idaho Springs and Georgetown in Clear Creek County, would permit trucks with legal weights and operating credentials to proceed nonstop. As an extension of the Trinidad automated POE, the recommended system would apply proven HELP/Crescent Program concepts and technologies consisting of a one-way automatic vehicle identification (AVI) system coupled with weigh-in-motion (WIM) technology, a computerized database, and a variable message sign (VMS) control system.

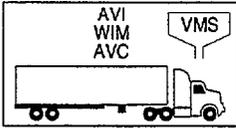
Utilizing the AVI technologies, commercial vehicles would be equipped with electronic tags that transmit vehicle identification, classification, and cargo information to a computerized monitoring system located in the Dumont/Downieville weigh/check station facility as the vehicle enters the station's jurisdictional area. Automatic checking and processing of vehicle information, compared to the database, would allow passage of the vehicle if all specifications are matched. A message to the truck driver to proceed would be electronically transmitted to the VMS. Alarms would sound if discrepancies occurred, allowing system operator intervention and stopping of the vehicle for inspection via the roadside VMS.

AVI technologies would also be used for monitoring vehicles carrying hazardous materials. The system would tag those vehicles and transmit identification information and approximate time of arrival to the Eisenhower Tunnel TOC. TOC operators would be on the "lookout" for these carriers to ensure that they are re-routed over Loveland Pass.

WIM detectors would be installed in the I-70 mainline pavements, preceding the station facility, to measure the weight of the vehicle. This information would be electronically transmitted to the station's computer for comparison to the previously recorded weight in the database. If weight measurements are comparable, the vehicle would be allowed continue without stopping, and a message would confirm this for the driver via the VMS. If inconsistencies are detected, a message would be conveyed via the VMS advising the driver to stop at the check facility. To enforce carrier member compliance, automatic vehicle classification (AVC) technology, using loop detectors installed in the I-70 mainline pavement, would determine if a vehicle required to stop actually does.

This system would be designed to incorporate a fee for commercial vehicle operators using the system to cover operations and maintenance costs incurred by CDOT. Unlike the Trinidad automated POE (as a test program, commercial vehicles outfitted with transponders bypass the facility free of charge), a fee would be levied to the carrier member's account for each non-stop use of the facility. CDOT would purchase and provide transponders to participating users. The transponders would contain electronic codes indicating that the particular vehicle equipped with the CDOT-provided device is a part of the system. Participating vehicle operators would prepay for the service and that information would be stored in the computerized database.

The system could be linked to other automated POEs, such as the St. George facility in Utah. Information on carriers traveling the I-70/I-15 routes could be passed between the St. George and Dumont/Downieville facilities to monitor weights, cargo, and credentials along the interstate system. Estimated time of arrival from one POE to the other would be calculated and transmitted, particularly for hazardous materials carriers.



PROJECT IDENTIFICATION:

cvo-2

PROJECT NAME:

Dumont/Downieville Automated Port of Entry

Currently, eastbound POE operators manually check truck braking systems when the commercial vehicles enter the check facility to ensure that the vehicles can descend the approaching steep downgrades safely. This manual method of spot checking is time-consuming and inaccurate. Portable brake test hardware is currently available, providing information on brake wear. It could be tied into the automated POE system. If brakes are worn beyond an acceptable threshold, drivers would be advised, via the VMS system, to stop. If brakes test in some range less than the threshold but show a potential for failure, a "be careful" or "proceed with caution" message could be conveyed to the driver via the VMS.

Two phases are recommended for implementation at the Dumont/Downieville POE. Phase I would equip the westbound lanes and facility with the system components since this access point has the greatest negative impact on the local community. Phase II would equip the eastbound lanes and facility at a later date and include the portable brake test system.

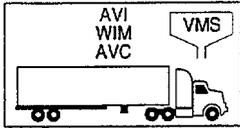
A third phase to this system might include a monitoring and processing system for compliance with state-mandated chain laws when pavement surfaces are snow-packed and/or icy. Private industry may develop sensing/monitoring technologies to detect the presence or absence of chains properly installed on vehicles; and provide advisories and warnings to the enforcement officials and vehicle operators.

PROBLEM RESOLUTION:

- Commercial vehicle queuing onto local access roads and interchange ramps.
- Commercial vehicle delays during peak check/weigh periods.
- Environmental and socio-economic impacts associated with the storage of large volumes of vehicles.
- Inefficient check/weigh operations.
- Removal of hazardous materials placards from vehicles after weigh/check clearance to pass undetected through Eisenhower Tunnel.
- Compliance and enforcement of state chain laws.

USER BENEFIT:

- Improved local traffic access and circulation.
- Operations time and cost savings at weigh/check station.
- Improved quality of life for the affected communities.
- Seamless movement for commercial vehicles.
- Reduced air and noise pollution.
- Controlled collection of fees associated with carrier member regulations.
- Safe ascent/descent of steep grades.
- Control of safe routes for hazardous materials shipments.



PROJECT IDENTIFICATION:

cvo-2

PROJECT NAME:

Dumont/Downieville Automated Port of Entry

PROJECT RATIONALE:

The Dumont and Downieville communities are concerned about the denigration of the local quality of life associated with check/weigh station activities. Allowing commercial vehicles with legal weights and operating credentials to bypass the Dumont/Downieville weigh/check station will not only improve the efficiency of individual trucking operations, but create a direct and positive impact on these communities.

Resulting improvements in mainline and local roadway operations will reduce the environmental impacts associated with noise and air pollution. This project will allow CDOT to respond to an urgent and pressing need to respond to this constituency's grievance and greatly improve those public relations.

Businesses in the area perceive that such a "pass by" facility would greatly diminish the daily revenues currently collected as commercial vehicle operators frequent local establishments. This possibility has been investigated. Economic indications show that CVO traffic will still patron local businesses at an equivalent level with the automated system in place, because it is a designated stop for cross-state commerce.

The project will provide better safety measurements for brake testing. This not only protects the commercial vehicle operator but other travelers and the environment (failing brakes give off noxious fumes). Revenues generated from prepaid fees will help pay for system operation and maintenance. CDOT will have the opportunity to test a non-technical aspect of ITS through the prepaid user fee system. The potential to monitor and enforce chain law requirements can significantly help to control I-70 closures due to overturned and jack-knifed vehicles blocking traffic lanes.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Division of Transportation Development: System planning/design/integration; testing and evaluation.

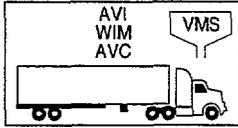
Region 1: Facility planning/design; equipment procurement/installation; operator training; testing and evaluation; operations and maintenance.

Colorado Department of Revenue, Port of Entry Division: Licensing, registration, permitting, transponder allocation, and fee collection; testing and evaluation.

PRELIMINARY COST ESTIMATE:

Phase I (Westbound)

Planning/Design/Evaluation:	\$50,000
Equipment/Implementation:	
Transponders (1000) :	\$50,000
WIM System:	\$200,000
AVC System:	\$200,000
VMS:	\$300,000
Operations/Maintenance:	\$30,000 Per Annum
Phase I Total (Excluding Operations/Maintenance):	\$ 800,000



PROJECT IDENTIFICATION:

cvo-2

PROJECT NAME:

Dumont/Downieville Automated Port of Entry

PRELIMINARY COST ESTIMATE (Continued):

Phase II (Eastbound)

Planning/Design/Evaluation:	\$50,000
Equipment/Implementation:	
Portable Brake Test:	\$100,000
WIM System:	\$200,000
AVC System:	\$200,000
VMS:	\$300,000
Operations/Maintenance:	\$30,000 Per Annum
Phase II Total (Excluding Operations/Maintenance):	\$ 850,000

(Note: Labor and associated administrative costs by the Colorado Department of Revenue, Port of Entry Division are expected to be included in that Division's annual operating budget.)

Approximate Cost-Sharing Arrangement (Phases I & II - Excluding Operations/Maintenance):

Colorado Department of Transportation:	\$1,590,000
<i>Division of Transportation Development:</i>	<i>\$40,000</i>
<i>Region I:</i>	<i>\$1,550,000</i>
 Colorado Department of Revenue, Port of Entry Division:	 \$60,000

IMPLEMENTATION PLAN:

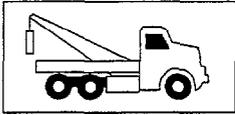
Phase I (Westbound)

Planning/Design:	January 1996 - June 1996
Procurement:	July 1996 - September 1996
Software Modifications (User Fee Inclusion):	July 1996 - September 1996
Installation:	September 1996 - November 1996
Testing/Evaluation:	November 1996 - December 1997

Phase II (Eastbound)

Planning/Design:	January 1998 - June 1998
Procurement:	July 1998 - September 1998
Installation:	September 1998 - November 1998
Testing/Evaluation:	November 1998 - December 1999

Phase III (Westbound and Eastbound) will require a private sector initiative to develop and design a detection system for chain use. This could occur at any time in the future.

**PROJECT IDENTIFICATION:**

ER-1

PROJECT NAME:

Hot Spot Courtesy Patrols

PROJECT DESCRIPTION:

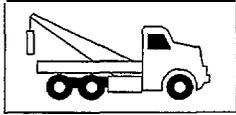
Implementation of Courtesy Patrols at high-incident locations during peak travel periods (holiday weekends, ski weekends, spring/fall sight-seeing weekends) and during extreme inclement weather would provide a highly beneficial service to the traveling public. Motorist assistance would include vehicle tows to safe refuge areas; gasoline; simple automobile breakdown diagnosis and repair; toll-free emergency calls; basic emergency medical assistance, and lifts to the nearest public outlet if the vehicle cannot be moved under its own power. The service providers would carry basic repair equipment and supplies. They would be trained and certified to provide rudimentary health safety procedures, such as CPR, until appropriate emergency medical service providers can respond.

Participating Courtesy Patrol providers would be outfitted with cellular telephones, provided by a sponsoring telephone communications company, that have special access codes for the provider to make other calls for help and for the stranded motorist to charge other advisory calls. Arrangements would be negotiable for certain additional services that the provider would be permitted to offer to the motorist for a fee.

High-incident locations may include Mount Vernon Canyon; Floyd Hill/Twin Tunnels/Idaho Springs area; the Frisco/Dillon/Silverthorne area; Tenmile Canyon/Vail Pass; the Vail/Dowd Junction area; and Glenwood Canyon.

Courtesy patrols are expensive to fund and can absorb much of CDOT's regional transportation budget allocations. A private sector initiative will be required to support and finance the program for the I-70 West Corridor. Mutually beneficial public/private partnerships need to be established. Program development and implementation would include:

- Evaluation of the Mile High Courtesy Patrol and other state courtesy patrol services to identify essential and non-essential program elements;
- Extension of the MOVE IT/REMOVE IT laws to the I-70 West Corridor;
- Design of a public relations campaign to promote the program, advertise the sponsors, and continually advise the public when the program is in effect;
- Identification of participating communications companies and other private sector sponsors;
- Design of a process to collect sponsoring dollars and funnel those monies through the CDOT Regions to pay the service providers;
- Development of a program plan that annually schedules periods for providing the service, identifies mobilization of the service for unplanned extreme inclement weather days, and the location(s), expanse and how many service vehicles will be in service for each of these periods;
- Design of a communications system to collect assistance requests and dispatch service providers;



PROJECT IDENTIFICATION:

ER-1

PROJECT NAME:

Hot Spot Courtesy Patrols

-
- Development of policies and procedures for managing and administering the program on an annual basis; and
 - Regular evaluation of the overall program and site-specific implementation.

PROBLEM RESOLUTION:

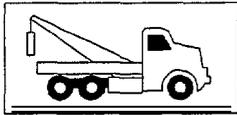
- Vehicular breakdowns and/or incidents that obstruct traffic flow.
- High altitudes, steep grades, and adverse weather conditions cause problems for vehicles not properly maintained.
- Motorist assistance by CDOT Maintenance personnel detracts from their higher priority duties.

USER BENEFIT:

- Reliable motorist assistance.
- Traveler security and peace of mind.
- Faster obstruction removal from travel lanes, lessening traffic congestion and accident potential.
- More effective use of maintenance/operations crews.
- Improved public relations.
- Economic stimulus for private service providers.

PROJECT RATIONALE:

Vehicular problems of every kind (such as stalls, lack of fuel, flats) create anxiety for the motorist involved (what to do and how or where to call for help; roadside safety; blocking traffic); and can cause frustration for other motorists as a result of induced congestion and potential subsequent accidents. Breakdown service assistance not only lessens the frustrations and anxieties of traveling motorists, but enables operations and maintenance crew efficiency and effectiveness on planned activities by not being called to respond to motorist problems. The intangible benefits associated with a courtesy patrol program to maintain smooth traffic flow, motorist peace of mind, and high public accolade offer immediate results and long-term potential for public investment and support of the program. For example, the general public may be much more willing to vote for an increased fuel tax hike if they know the dollars will be spent for a service that will benefit them if they encounter car troubles in a remote, rural area.



PROJECT IDENTIFICATION:

ER-1

PROJECT NAME:

Hot Spot Courtesy Patrols

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Stuff Traffic/ITS Program Office: Initiate and manage program development; evaluate other courtesy patrol programs; coordinate design of communications systems and development of policies and procedures for program administration and management.

Business Development: Administer extension of MOVE IT/REMOVE IT laws to I-70 West Corridor; coordinate communications company involvement; assist with revenue collection and dispersal procedures.

Public Relations: Develop and implement public relations and advertising program.

Region 1: Identify courtesy patrol service locations; assist with communications system design and development of policies and procedures; design annual program schedules; manage and administer program operation for Hogback to Vail Pass services; program evaluation.

Region 3: Identify courtesy patrol service locations; assist with communications system design and development of policies and procedures; design annual program schedules; manage and administer program operation for Vail to Glenwood Springs services; program evaluation.

Colorado Division of Public Safety: Assist with communications system design; assist in locating motorist assistance needs and dispatch of services.

Local County/Municipal Governments: Assist in identifying local-area private sector sponsors; allocate local funds to support program operation; assist in promoting program locally.

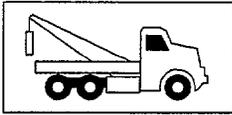
Service Providers: Provide courtesy patrol services; share service costs in exchange for advertising.

Communications Companies: Supply cellular equipment and service; invest advertising dollars to fund program; assist with communications system design.

Private Sector Sponsors: Invest advertising dollars to fund program.

PRELIMINARY COST ESTIMATE:

Program Planning/Design:	\$100,000
Program Implementation:	\$600,000 Per Annum



PROJECT IDENTIFICATION:

ER-1

PROJECT NAME:

Hot Spot Courtesy Patrols

PRELIMINARY COST ESTIMATE (Continued):

Approximate Cost-Sharing Arrangement for Program Planning/Design:

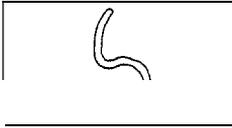
Colorado Department of Transportation:	\$85,000
<i>Staff Traffic/ITS Program Office:</i>	<i>\$25,000</i>
<i>Business Development:</i>	<i>\$10,000</i>
<i>Public Relations:</i>	<i>\$10,000</i>
<i>Region 1:</i>	<i>\$20,000</i>
<i>Region 3:</i>	<i>\$20,000</i>
Colorado Division of Public Safety:	\$5,000
Local County/Municipal Governments:	\$5,000
Communications Companies:	\$5,000

Approximate Cost-Sharing Arrangement for Program Implementation (Annually):

Colorado Department of Transportation:	\$70,000
<i>Public Relations:</i>	<i>\$10,000</i>
<i>Region 1:</i>	<i>\$30,000</i>
<i>Region 3:</i>	<i>\$30,000</i>
Colorado Division of Public Safety:	\$5,000
Local County/Municipal Governments:	\$5,000
Communications Companies:	\$10,000
Private Sector Sponsors:	\$500,000
Service Providers:	\$10,000

IMPLEMENTATION PLAN:

Program Planning/Design:	November 1996 - June 1998
Initial Courtesy Patrol Implementation:	September 1998 (<i>Labor Day weekend</i>)
Program Evaluation:	September 1998 - October 1998
Courtesy Patrol Continuation:	November 1998 - September 1999
Site-Specific Program Evaluation:	<i>(each month following planned and unplanned service)</i>
Overall Annual Program Evaluation:	October 1999 - November 1999
Program Continuation Determination:	November 1999

**PROJECT IDENTIFICATION:**

cs-2

PROJECT NAME:

High-Capacity Data Transmission Links

PROJECT DESCRIPTION:

Fiber optic communications media have been identified as the most reliable bounded media technology to provide high transmission links between roadside infrastructure, TOCs, and the various agencies that support transportation operations/maintenance; traffic enforcement/regulation; and fire/emergency response.

Fiber optic technology can be expensive to install and maintain, compared to other communications technologies, because cables may have to be buried. Funding-related issues that need to be resolved before installation include:

- Solicitation of private organizations willing to install fiber optic cable.
- Enabling legislation to allow private use of public rights-of-way.
- Installation and maintenance rights and responsibilities.
- Redundant systems in case of cable damage.

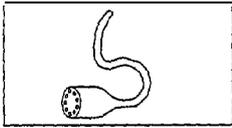
Because of the high cost and other potential uses, CDOT must rely on private industry initiatives to install fiber optic cable throughout the I-70 West Corridor. CDOT should be receptive to all fiber project proposals and find ways to help private industry complete their fiber installation projects. This includes continuing the current investigation and development of modifications to existing legislation, rules, and regulations.

If CDOT desires to link the I-70 West Corridor completely to the state microwave system, that connection is feasible through construction of a microwave relay tower or reflector. A reflector is particularly attractive because it is an entirely passive element that does not require external power. With a reflector connection, microwave receivers and antennas would be the only active components required for installation at the Eisenhower Tunnel and at one of the existing repeater sites nearest the tunnel. However, microwave dishes require line-of-sight communications which can present a difficulty in the mountainous terrain encompassing I-70. Additional tower sites will increase costs to maintain continuous data transmission.

This project provides the long-term corridor communications solutions previously met with the interim architecture proposed in Early Action Project CS-4, Voice/Data Communications Upgrades. Additionally, this project would expand upon the 17 miles of fiber optic cable installed in Glenwood Canyon under Early Action Project CS-9, Hanging Lake TOC Upgrades, to provide the entire I-70 West Corridor with high-capacity communications.

PROBLEM RESOLUTION:

- Unreliable and poor-quality communications links.



PROJECT IDENTIFICATION:

cs-2

PROJECT NAME:

High-Capacity Data Transmission Links

USER BENEFIT:

- Reliable high-capacity data transmission.
- Connectivity for future systems.
- Labor savings through more efficient use of time.
- Digital and analog data conveyance.
- Other information superhighway functions designated for rural environments (such as long distance education and medicine)

PROJECT RATIONALE:

Data-intensive ITS applications require accurate and reliable communications links to transmit and receive information. Any initiative to develop high-capacity data transmission links is worthwhile to explore and support.

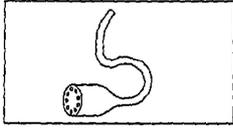
The existing state-owned microwave system (unbounded media) uses wireless transmission technology that is subject to atmospheric and terrain disturbances and currently does not support adequate line-of-site equipment to provide complete communications coverage along the I-70 West Corridor. Consequently, some key facilities, most importantly the Eisenhower Tunnel, are not linked to the microwave network. A corridor-wide fiber optic network will be much more valuable than providing corridor-wide microwave coverage. Additional user benefits outside transportation can be accomplished via fiber by supporting other information superhighway functions to rural areas.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation: Support for fiber network proposals; continuation of legislative and organizational change campaigns; facilitate fiber installation in the I-70 West Corridor if installed; lease fiber communications from owner if installed in the I-70 West Corridor; decision to connect Eisenhower Tunnel with state microwave system; microwave equipment procurement and installation, if necessary.

Colorado Division of Telecommunications: Support microwave communications connections for Eisenhower Tunnel, if needed.

Private Communication Companies: Initiate, install, and maintain fiber optic cabling throughout the I-70 West Corridor.



PROJECT IDENTIFICATION:

cs-2

PROJECT NAME:

High-Capacity Data Transmission Links

PRELIMINARY COST ESTIMATE:

Fiber Optic Program Support:	\$25,000
Fiber Optic Cable Installation:	\$10 - \$50 Per Foot *
Fiber Optic Communications Lease:	(to be negotiated when available)
Microwave Equipment/Installation:	\$200,000 Per Site

* **Depending on type and conditions of installation, price per foot will vary dramatically. Installation estimates: \$10/foot to hang fiber; \$20/foot for installation in existing conduit; \$25 to \$50/foot to trench and bury with conduit in various soil types.**

Approximate Cost-Sharing Arrangement:

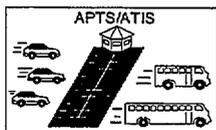
Colorado Department of Transportation: \$25,000

Colorado Division of Communications: \$200,000

Private Communication Companies: (variable)

IMPLEMENTATION PLAN:

This project is on-going and should be supported in whatever manner necessary to facilitate high-capacity transmission media installation (fiber or microwave) throughout the I-70 West Corridor.

**PROJECT IDENTIFICATION:**

PTAM-1

PROJECT NAME: Summit Stage Transfer Center APTS/ATIS Operational Test

PROJECT DESCRIPTION:

Summit Stage, the public transportation operator for Summit County, operates a hub-and-spoke, fixed-route, year-round bus system serving the Breckenridge, Copper Mountain, and Keystone resort areas and the towns of Dillon, Frisco, and Silverthorne. This public transportation system offers an ideal chance to test and evaluate integration of an Advanced Public Transportation System (APTS) with an Advanced Traveler Information System (ATIS) serving the eastern segment of the I-70 West Corridor. The opportunity exists to develop this system through a request for funding through FHWA as an ITS Operational Test.

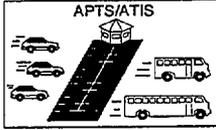
The APTS/ATIS strategy would include development of an intermodal transfer center in the Frisco area, designed to accommodate multi-modal regional trips along I-70 and local county trips via single occupancy vehicle (SOV), bus, van, carpool, bicycle, and pedestrian modes. As an intercept station, this Summit Stage Transfer Center (SSTC) is expected to serve as a regional destination/collection point for redistribution of travelers onto the Summit Stage to reach local destinations. The SSTC would support an ATIS center, providing direct information links with the Denver Metro, Eisenhower Tunnel, and Hanging Lake TOCs where real-time travel information from DIA, the Denver metropolitan area, and the I-70 corridor would be processed and disseminated. Establishing an ATIS at Denver International Airport (DIA) would be an integral part of this system.

Summit Stage buses and participating private transit operations vans would be equipped with AVL/GPS technology to track vehicle progression and monitor schedule adherence. This information would be transmitted back to the ATIS so that riders would know exact arrival/departure times. The vehicle tracking system would allow automated scheduling, maintenance, service, and system administration and management capabilities. Other area public transportation providers (Breckenridge Trolley, Frisco Flyer, and the Keystone, Breckenridge, and Copper Mountain resort shuttles) can be readily added to integrate all local transit systems.

In addition to fixed-route schedules, the system would incorporate paratransit and demand-responsive programs to serve the elderly and handicap population of the county. Additional ADA-accessible vans would be added to the fleet, each equipped with the AVL/GPS tracking devices and computer-aided dispatch (CAD). Summit Stage would become the managing and administering organization. The municipal and resort public transportation providers would pay an annual fee to be a part of the system.

A diligent marketing campaign should be initiated to encourage use of the system. The ATIS kiosk at DIA would be equipped with a service-specific module to inform and influence arriving passengers to take a participating private transit shuttle to the Summit County resort facilities. Special recreational packages could be developed through travel agents as a nationwide marketing tool. The tracking system would be billed as a prototype for improving rural transit management and operations.

Incentive programs to encourage system use would be implemented (discounted lift tickets, accommodations, and transportation or combination packages thereof). These discounts would have to be validated by the transit service driver to be accepted at the resorts.

**PROJECT IDENTIFICATION:**

PTAM-1

PROJECT NAME: Summit Stage Transfer Center APTS/ATIS Operational Test

In the future, as a further incentive to encourage commuter use, local roadways (SH 9 between Frisco and Breckenridge and US 6 between Frisco and Keystone) could be congestion priced during peak hours: SOVs would pay a toll while HOVs (3 or more persons per vehicle) would use the facilities free of charge.

PROBLEM RESOLUTION:

- Lack of a true intermodal transfer/information center in Summit County.
- Inadequate financial resources.

USER BENEFIT:

- Encourages public transportation use.
- Potential reduction in the number of vehicles traveling I-70/other local corridors during peak periods and/or spreading of peak period to reduce congestion.
- Potential air quality/other environmental improvements.
- Improved management/scheduling for Summit Stage/other Summit County transit providers.
- Integration of Summit County public transportation systems.
- Real-time/comprehensive information access.
- Coordinated/cooperative effort between agencies.
- Improved relationships between state and local governments.

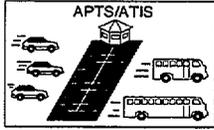
PROJECT RATIONALE:

More HOV usage for travel through the I-70 West Corridor, particularly along the stretch between Denver and Vail, could greatly improve mobility, safety, and the quality of the physical and social environment. An integrated public and private transit and information system between the trip attractors and generators (Denver and the Keystone/Frisco/Dillon/Silverthorne/Copper Mountain/Breckenridge communities), that is well-managed and administered and that is easy to use, has high potential for enhancing commuter and recreational trips.

Summit Stage, in their current efforts to acquire property for a time-transfer center for their local operations, provides a prime opportunity to develop a multi-modal collection/distribution center at this site. CDOT has allocated funds to assist in the acquisition and related transportation facility construction. The desired site has ample land area for future development of the multi-modal information/transfer center.

Private shuttle operators and local businesses are willing to cost share (soft costs) in the program to the extent of their capability. Travel along the I-70 West Corridor affects Summit County, particularly when skiers are caught in traffic or weather that encourages them to "wait out the storm" at the local establishments.

The proposed project has been used as a national research example to investigate how public-private partnerships can be initiated. This national exposure has increased the potential for some sort of federal ITS funding for the project. The US DOT Joint Program Office has also stepped-up Advanced Rural Transportation System investments that can serve as a catalyst for allocating federal dollars to this project.



PROJECT IDENTIFICATION:

PTAM-1

PROJECT NAME: Summit Stage Transfer Center APTS/ATIS Operational Test

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation, Region 1: Program funding, planning, design, integration, and installation, and facility construction; property acquisition; system evaluation; roadway/IVHS operations and maintenance.

Summit County/Summit Stage: Assistance with program funding and system planning and design; development of county-wide transit programs; property acquisition; management and administration of transit system programs; transit operations and maintenance; system evaluation.

Frisco/Breckenridge/Dillon/Silverthorne: Annual fee payment for system connectivity; participation in paratransit/demand-responsive programs.

City and County of Denver: Donation of space at Denver International Airport for ATIS kiosk.

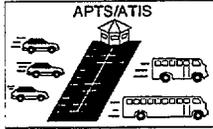
Private Transit Operators: Donation of travel incentives; vehicles instrumented as probes; connectivity to system; on-system advertising.

Ski/Resort Area Operators: Financial investment to procure/construct advanced technology components; on-system advertising; donation of incentives; annual fee payments for system connectivity.

Private Industry: System planning, design, and integration cost-sharing through partial donation of services; equipment cost-sharing through partial donation of advanced technology devices; local business participation in incentive program.

PRELIMINARY COST ESTIMATE:

Program Funding/Planning/Design:	\$800,000
Equipment/Implementation:	
Computer Systems (8):	\$80,000
Communications Devices:	\$40,000
Communications Links:	\$200,000
AVL/GPS Devices (100):	\$50,000
Paratransit Vans (4):	\$80,000
Property Acquisition:	\$500,000
Construction:	
SSTC Site Development:	\$200,000
Information Kiosks:	\$140,000
Roadway Improvements:	\$100,000
Program Evaluation:	\$50,000



PROJECT IDENTIFICATION:

PTAM-1

PROJECT NAME: Summit Stage Transfer Center APTS/ATIS Operational Test

PRELIMINARY COST ESTIMATE (Continued):

Operations/Maintenance:

Summit County Transit Systems:	\$20,000 Per Annum
Private Transit Probes:	\$5,000 Per Annum
Incentives Program:	\$10,000 Per Annum
Information Systems:	\$20,000 Per Annum
Roadway Systems:	\$50,000 Per Annum

Project Total (Excluding Operations/Maintenance): **\$2,240,000**

(Note It is assumed that management and administration of transit systems will be allocated in the operating agency's annual budget.)

Approximate Cost-Sharing Arrangement (Excluding Operations/Maintenance):

Federal Funding:	\$900,000
<i>FHWA ITS Deployment Programs:</i>	<i>\$800,000</i>
<i>FTA Funding (Paratransit Programs):</i>	<i>\$100,000</i>
Colorado Department of Transportation, Region 1:	\$640,000
Summit County/Summit Stage:	\$200,000
Ski/Resort Area Operators:	\$300,000
Private Industry:	\$200,000

IMPLEMENTATION PLAN:

Funding Identification/Allocation:	January 1996 - July 1996
Planning/Design:	July 1996 - December 1996
Installation/Construction:	December 1996 - December 1997
System Start-Up/Testing:	January 1998 - February 1999
Evaluation:	February 1999 - February 2000
Congestion Pricing:	(to be determined)



PROJECT IDENTIFICATION:

SW-1

PROJECT NAME:

Incident Investigation Sites

PROJECT DESCRIPTION:

Construction of pull-outs at known high-incident locations along the I-70 West Corridor would provide a safe refuge to clear vehicles and debris from the travel lanes. Police and response teams would be able to safely conduct accident investigations from these sites, allowing traffic to pass unimpeded. The pull-outs could also function as a safe refuge for motorists to pull off to the roadside or clear disabled or abandoned vehicles, when investigation sites are not in use.

Initially, CDOT would construct an appropriate number of pull-outs over a three year period, beginning with sites where the safety need is greatest and where public approval is most opportune. These sites might include Mount Vernon Canyon, Floyd Hill, between Twin Tunnels/Idaho Springs; near Georgetown; Eisenhower Tunnel; Dillon Valley; Tenmile Canyon/Vail Pass; Dowd Junction; Eagle/Gypsum area; and both ends of Glenwood Canyon. Existing pull-off areas at interchanges and make-shift park-and-ride lots can also be used as incident investigation sites. The program can be expanded throughout the I-70 West Corridor as additional funding becomes available to facilitate more sites.

Incident investigation sites would incorporate the following features:

- Paved or well-graded site to accommodate multiple vehicles;
- Roadside and median access;
- Two-way emergency call boxes for investigation communications and general public toll calls;
- Automatic entrance gate and "in-use" signage to block general access when an investigation is being conducted;
- Power and lighting to facilitate investigations;
- Landscaping/berming/walls to block travelway views into site; and
- Security systems (lighting, fencing, video surveillance) to deter vandalism.

Project activities would include:

- Development of Incident Investigation Site Design Guidelines and Standards;
- Collection and databasing of historical information on blockage and clearing time periods, secondary incidents resulting from initial accident, and high-incident locations;
- Location and design of high priority sites;



PROJECT IDENTIFICATION:

SW-1

PROJECT NAME:

Incident Investigation Sites

-
- Phased site construction; and
 - Evaluation of effectiveness, including number of usages and increased investigation efficiency, and before and after comparisons of clearing and travel time delays and secondary accidents.

PROBLEM RESOLUTION:

- Accidents and stalls create blockage of travel lanes.

USER BENEFIT:

- Traveler Safety
- Response Team Safety
- Travel Delay Reduction

PROJECT RATIONALE:

Accidents block travel lanes, resulting in traffic flow disruptions, traveler frustration, and unsafe driving and roadside conditions. Curiosity slowing exacerbates these problems. Similar systems have shown success in other states. This project provides an opportunity for CDOT to enhance rural travel safety for motorists as well as incident investigators and response teams and to evaluate the benefits associated with the system to improved mobility, increased safety, and reduced secondary accidents. As a test case, the program will provide a model for developing incident investigation sites along other state highway and interstate corridors throughout the state.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Staff Traffic/ITS Program Office: Development of standards and guidelines; assistance with design and implementation.

Region 1: Historical information cataloging; site location identification; site design and construction; program evaluation; operations and maintenance for pull-outs between the Hogback and Vail Pass.

Region 3: Historical information cataloging; site location identification; site design and construction; program evaluation; operations and maintenance for pull-outs between Vail and Glenwood Springs.

Colorado Department of Public Safety, Division of State Patrol: Historical information cataloging; input to standards and guidelines development; construction cost-sharing; site surveillance.

Communications Companies: Donation and maintenance of communications equipment for call boxes.



PROJECT IDENTIFICATION:

SW-1

PROJECT NAME:

Incident Investigation Sites

PRELIMINARY COST ESTIMATE:

Design Guidelines and Standards:	\$50,000
Site Design (12 sites):	\$10,000 Per Site
Equipment/Implementation:	
Call Boxes:	\$5,000 Per Site
Barrier Gates/Signs:	\$15,000 Per Site
Video Surveillance:	\$10,000 Per Site
Site Development (<i>includes labor and materials</i>):	\$10,000 to \$50,000 Per Site
Operations/Maintenance:	\$20,000 Per Site Per Annum

Project Total

(Assuming 6 Sites Per Region; Excluding Operations/Maintenance): \$650,000 - \$1,130,000

Approximate Cost-Sharing Arrangement (Excluding Operations/Maintenance):

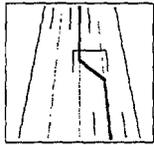
Colorado Department of Transportation:	\$545,000 - \$1,025,000
<i>Staff Traffic/ITS Program Office:</i>	\$65,000
<i>Region 1:</i>	\$240,000-\$480,000
<i>Region 3:</i>	\$240,000-\$480,000

Colorado Department of Public Safety, Division of State Patrol: \$45,000

Communications Companies: \$60,000

IMPLEMENTATION PLAN:

Guidelines/Standards Development:	January 1996 - May 1996
Site Location/Data Collection:	June 1996 - March 1997
Site Designs:	March 1997 - September 1997
Site Construction:	April 1998 - July 1998
	April 1999 - July 1999
	April 2000 - July 2000
Program Evaluation:	July 1998 - December 2000



PROJECT IDENTIFICATION:

TMO-3

PROJECT NAME:

Automated Reversible Lane Program

PROJECT DESCRIPTION:

Automation of the Eisenhower Tunnel 3: 1 lane split operation, currently implemented during eastbound high volume travel periods (Sunday afternoons/evenings on holiday weekends), would dramatically facilitate system set-up and knock-down as peak periods expand. The manual operation requires four people eight hours each the previous and subsequent days to move barriers, signs, and sandbags to and from the staging areas. This equates to a cost of \$2,000 per deployment and removes those individuals from the day-to-day staffing and emergency response requirements. The set-up and knock-down operations take 45 minutes each, requiring 20 workers and 5 supervisors. This equates to \$1,500 per deployment, and, again, takes staff away from day-to-day operations.

An automated system would include an automated hydraulic barrier transfer system consisting of jersey-style barriers mounted on rubberized tires with a motor to propel the system. This portion of the system would be installed along the tunnel approaches. Inside the tunnel, pop-up barriers would be installed every 20 feet along the center lane stripe. The automated barrier moves at a speed of 5 miles per hour. At 1,600 linear feet at the east portal, the outside barriers would be repositioned in 5 minutes. The tunnel pop-up barriers position up or down within minutes. The 3:1 lane configuration could, ideally, be deployed instantaneously in response to heavy traffic volume.

Based on automated system capital costs versus the manpower required to set-up/knockdown the operation, it would take approximately 550 sequences to recover the initial costs of the automated system. Evaluation of system performance, operating and maintenance costs, and the ability to deploy the 3: 1 split at any time, would provide measures of effectiveness for deploying the system in other high volume locations. System implementation may qualify for federal funding under Section 10-58 of the ISTEA legislation, for barriers used in permanent lane change operations.

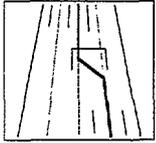
Phase I of the system would include 2,400 feet of outside moveable barrier (1,600 feet at the east portal and 800 feet at the west portal) and pop-up barriers in the eastbound tunnel (along with 2 motors -- 1 on the east end and 1 on the west end -- to move the barriers). A variable message sign (VMS), positioned along the eastbound lanes prior to west tunnel portal, would provide advance warning to approaching motorists of the lane split configuration.

Phase II, if evaluation indicates sufficient benefit, would include an additional 2,400 feet of outside movable barrier (1,600 feet at the east portal and 800 feet at the west portal), installation of pop-up barriers in the westbound tunnel and a VMS advisory sign along the westbound lanes prior to the east tunnel portal.

VMS can be used for other advisories when the standard lane configuration is operating.

PROBLEM RESOLUTION:

- Increasing peak period travel demands.



PROJECT IDENTIFICATION:

TMO-3

PROJECT NAME:

Automated Reversible Lane Program

USER BENEFIT:

- Decrease in traffic bottlenecks during peak periods,
- Very high public acceptance.
- Implementation at any time.
- Efficient use of resources.
- Improved air quality.
- Increased energy efficiency (tunnel ventilation system can operate at lower output as traffic is moved through the tunnel more quickly).

PROJECT RATIONALE:

The current reversible lane program at the Eisenhower Tunnel has been a resounding success. Program implementation requires advance planning due to the required prior day preparation. Automation of the system would allow immediate implementation any time traffic volumes begin to snarl the traffic flow. It would also allow operation in the westbound direction as well. System evaluation would provide cost and benefit information for potential implementation in other segments of the I-70 West Corridor where recurrent traffic congestion is a problem.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation Region 1: Funding, equipment procurement, installation, operations, and maintenance.

PRELIMINARY COST ESTIMATE:

Phase I (Eastbound):

Equipment:

Hydraulic Jersey-Style Barrier (2400 feet):	\$200,000
Motors (2):	\$1,000,000
Pop-Up Barriers (525):	\$275,000
VMS:	\$150,000

Installation:

Operations/Maintenance:

\$25,000 Per Annum

Phase I Total (Excluding Operations/Maintenance)

\$1,875,000

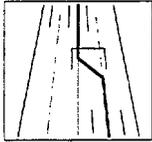
Approximate Phase I Cost-Sharing Arrangement (Excluding Operations/Maintenance):

Federal Funding:

\$500,000 - \$1,000,000

Colorado Department of Transportation, Region 1:

\$875,000 - \$1,375,000



PROJECT IDENTIFICATION:

TMO-3

PROJECT NAME:

Automated Reversible Lane Program

PRELIMINARY COST ESTIMATE (continued):

Phase II (Westbound):

Equipment:

Pop-Up Barriers:

\$275,000

VMS:

\$150,000

Installation:

\$225,000

Operations/Maintenance:

\$10,000 Per Annum

Phase II Total (Excluding Operations/Maintenance):

\$650,000

Approximate Phase II Cost-Sharing Arrangement (Excluding Operations/Maintenance):

Federal Funding:

\$300,000 - \$350,000

Colorado Department of Transportation, Region 1:

\$300,000 - \$350,000

IMPLEMENTATION PLAN:

Pursue Funding:

January 1997 - June 1997

Phase I (Eastbound)

Equipment Procurement:

January 1998 - June 1998

Installation:

June 1998 - August 1998

Evaluation:

August 1998 - December 1999

Phase II (Westbound)

Equipment Procurement:

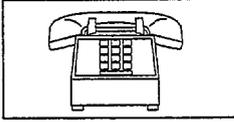
January 1999 - June 1999

Installation:

June 1999 - August 1999

Evaluation:

August 1999 - December 2000

**PROJECT IDENTIFICATION:**

ER-3

PROJECT NAME:

Corridor-Wide Call Box System

PROJECT DESCRIPTION:

Installation of cellular or land line telephone equipment at regular intervals throughout the I-70 West Corridor (every 1/2-mile in high-incident locations; every mile elsewhere) will provide the traveling motorist with communications access to report problems or needs. Communications companies would install and maintain solar-powered call boxes with two-way communications capabilities for motorists to make a toll-free emergency call using the *999 system. Additionally, motorists could make any number of credit card or collect calls from these telephones. This project would expand upon the approximately 17 miles of roadside call boxes installed in Early Action Project CS-9, Hanging Lake TOC Upgrades.

This project will be guided by private industry initiative. CDOT responsibilities would include:

- Promotion of corridor-wide need to encourage industry initiative;
- Positive reception to any proposals;
- Investigation and modification of rules, regulations, and/or legislation to support acceptable proposals;
- Minor roadway/roadside improvements to provide safe and adequate access; and
- Promotional campaigns as systems are deployed.

PROBLEM RESOLUTION:

- Inability of traveling motorists to get help or communicate problems.

USER BENEFIT:

- Traveler security and service for breakdowns.
- Improved public perception of CDOT/sponsoring organizations.

PROJECT RATIONALE:

I-70 West Corridor travelers must currently rely on good Samaritans to assist in times of trouble or need. A corridor-wide call box system would greatly enhance traveler security and safety, particularly in remote, sparsely populated areas. This project would promote high public approval ratings.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:**Colorado Department of Transportation:**

Business Development: Promotion of need; investigation into legal and regulatory restrictions; campaigns to remove institutional barriers; coordination of acceptable proposals.

Public Relations: Promotional campaigns as systems are deployed.



PROJECT IDENTIFICATION:

ER-3

PROJECT NAME:

Corridor-Wide Call Box System

Region 1: Roadway/roadside access improvements for call box sites between the Hogback and Vail Pass.

Region 3: Roadway/roadside access improvements for call box sites between Vail Pass and Glenwood Springs.

Private Industry: Initiation, installation, operations, and maintenance of call boxes within the I-70 West Corridor.

PRELIMINARY COST ESTIMATE:

Program Development:	\$10,000 per annum
Access Improvements:	\$5,000 to \$10,000 per site
Equipment/Implementation:	
Call Boxes:	\$5,000 per site
Promotional Campaign:	\$10,000 per annum

Approximate Cost-Sharing Agreement:

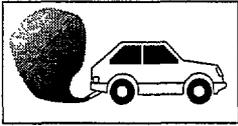
Colorado Department of Transportation:

Business Development:	\$10,000 per annum
Public Relations:	\$10,000 per annum
Region 1:	\$5,000 - \$10,000 per site
Region 3:	\$5,000 - \$10,000 per site

Private Industry: \$5,000 per site

IMPLEMENTATION PLAN:

Marketing Need:	(on-going, beginning in 1996)
Access Improvements:	(as call boxes are installed)
Promotional Campaign:	(annually, following installation)

**PROJECT IDENTIFICATION:**

EEI-5

PROJECT NAME:

Mobile Emissions Testing Stations

PROJECT DESCRIPTION:

Following successful evaluation of the recently funded CDOT emissions detection and reporting operational test, Mobile Emissions Testing Stations would be installed in potential high-pollution locations within the I-70 West Corridor. Phase I of the program would involve setting up three emission detecting stations along the roadside to ascertain which passing vehicles are emitting unacceptable levels of carbon monoxide (CO). Identified vehicle drivers would receive a warning, via a portable variable message sign (VMS), indicating they are in violation of emission standards. Daily logs of the number of suspect vehicles detected would be maintained. The number of stations would be expanded if the logs indicate that a significant number of vehicles traveling the I-70 West Corridor violate standards.

Initial Phase I locations for emission detection stations could include Mount Vernon Canyon, the Vail Valley, and Glenwood Canyon. Phase I program activities would include:

- Identification of station locations;
- Development of an evaluation methodology and measures of effectiveness (MOEs);
- A public relations program to disseminate test information; and
- Evaluation of system results.

Phase II would depend on legislative changes. The system would be upgraded to include video surveillance systems that record vehicle identification (licence plate number). These would be transmitted to the Department of Revenue to levy fines on the vehicle owner for not meeting emission standards. The City of New York currently uses a similar video surveillance system to fine vehicle owners who are caught on camera running red lights. The general public has been very positive and accepting of this system.

If a particular vehicle violates the emission standards more than a specified number of times, the system would automatically notify law enforcement authorities so that the vehicle could be "booted" or impounded.

Phase II activities would involve initiation of legislative changes to allow vehicle recordation to levy fines for moving violations (including air pollution).

PROBLEM RESOLUTION:

- Vehicles traversing the I-70 West Corridor emitting noxious pollutants.

USER BENEFIT:

- Air quality improvement.
- Enhanced quality of life for area communities.
- Control of CO emissions.
- Justification for ITS to improve environmental quality.



PROJECT IDENTIFICATION:

EEI5

PROJECT NAME:

Mobile Emissions Testing Stations

PROJECT RATIONALE:

Vehicular emissions are becoming an increasingly important concern as air pollutants continue to increase beyond air quality conformance standards. Environmentalists persist in opposing ITS applications because they believe that advanced technologies will increase capacity on existing facilities and therefore encourage more vehicle miles to be traveled resulting in additional vehicular pollutants contaminating the atmosphere. Local communities express great concern regarding the increasing vehicular traffic that pollutes their pristine environment. This project offers CDOT the opportunity to monitor air quality and enforce vehicular pollutant maximums, gaining widespread public acceptance and environmental quality approvals. It will also provide a medium to measure the effectiveness of ITS applications to not only increase mobility and improve safety, but to protect quality of life along the I-70 West Corridor.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Staff Traffic/ITS Program Office: Development of MOE's and evaluation methodology; assistance with project evaluation.

Public Relations: Development and implementation of public relations program.

Region 1: Station site selection; equipment procurement; operations and maintenance; and evaluation for stations deployed within the I-70 West Corridor between the Hogback and Vail Pass.

Region 3: Station site selection; equipment procurement; operations and maintenance; and evaluation for stations deployed within the I-70 West Corridor between Vail Pass and Glenwood Springs.

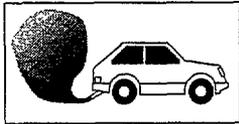
Department of Revenue: Assessment and collection of violations.

Law Enforcement Agencies: Boot or impound vehicles of chronic violators.

PRELIMINARY COST ESTIMATE:

Phase I:

Program Development:	\$15,000
Equipment/Implementation:	
Emission Testing Stations (3):	\$30,000
Portable VMS (3):	\$120,000
Site Development:	\$15,000
System Evaluation:	\$60,000
Public Relations Program:	\$20,000
Operations/Maintenance:	\$10,000 Per Annum
Phase I Total (Excluding Operations/Maintenance):	\$260,000



PROJECT IDENTIFICATION:

EEL-5

PROJECT NAME:

Mobile Emissions Testing Stations

Approximate Cost-Sharing Arrangement (Excluding Operations/Maintenance):

Colorado Department of Transportation:	\$260,000
<i>Staff Traffic/ITS Program Office:</i>	<i>\$20,000</i>
<i>Public Relations:</i>	<i>\$20,000</i>
<i>Region 1:</i>	<i>\$110,000</i>
<i>Region 3:</i>	<i>\$110,000</i>
Phase II:	
Planning:	\$50,000
Software Development:	\$50,000
Equipment Procurement:	
Surveillance Cameras (3):	\$30,000
Computer System (1):	\$10,000
Security Systems (3):	\$30,000
Installation:	\$30,000
Evaluation:	\$60,000
Operations/Maintenance:	\$15,000 Per Annum
Violations Processing:	\$15,000 Per Annum
Law Enforcement:	\$15,000 Per Annum
Phase II Total	
(Excluding Operations/Maintenance, Processing and Enforcement):	\$260,000

Approximate Cost-Sharing Arrangement
(Excluding Operations/Maintenance, Processing, and Enforcement):

Colorado Department of Transportation:	\$260,000
<i>Staff Traffic/ITS Program Office:</i>	<i>\$80,000</i>
<i>Public Relations:</i>	<i>\$20,000</i>
<i>Region 1:</i>	<i>\$80,000</i>
<i>Region 3:</i>	<i>\$80,000</i>

IMPLEMENTATION PLAN:

Phase I:	
Planning:	January 1997 - June 1997
Equipment Procurement:	June 1997 - July 1997
Installation and Testing:	August 1997 - September 1997
Evaluation:	October 1997 - October 1998



PROJECT IDENTIFICATION:

EEI-5

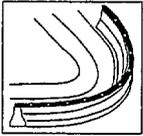
PROJECT NAME:

Mobile Emissions Testing Stations

IMPLEMENTATION PLAN (Continued):

Phase II:

Planning:	October 1997 - December 1998
Software Development:	January 1999 - March 1999
Equipment Procurement:	March 1999 - April 1999
Installation and Testing:	May 1999 - June 1999
Evaluation:	July 1999 - July 2000



PROJECT IDENTIFICATION:

SW-4

PROJECT NAME:

Advanced Technology Roadway Delineation

PROJECT DESCRIPTION:

Installation of lighted edge-of-pavement delineation systems on median and outside shoulder barriers and guardrails would improve drivers' ability to distinguish the outer boundaries of the roadway travel path through continuous lighted guidance. Lighted guidance systems, such as the 3M Guidance Tube, use a special reflective tubing that transmits light along the length of the tube, either mono or bi-directionally (median applications would use the bidirectional reflective material; outside shoulder applications would use the single direction reflective material). Power would be needed every 2,000 feet for a mono-directional system, and every 1,000 feet for a bi-directional system, to run 50 watt lamps spaced throughout the length of the tube. Each lamp is capable of illuminating 100 feet of tubing.

These systems can be portable, are easily assembled, and fixed on top of jersey-style barriers or other structures. They can be powered temporarily by a generator. CDOT would maintain several portable systems to delineate construction zones or accident locations.

Installations could initially be placed on bridge and guard rails at sharp curve locations and at known locations where blowing snow and snow pack typically obstruct edge-of-pavement boundaries. Temporary installation could be used throughout corridor construction zones to increase driver awareness. Project activities would include identification of priority location installations and decisions as to whether installations should be made in the median or along the outside shoulder or both.

A 2,000-foot Lighted Guidance Tube installation was deployed, in July 1994, along the median barrier of I-70 at milepost 171.4 west of Vail near Dowd Junction. This test section is currently being evaluated by CDOT Region 3. Maintenance of the tube (washing away road dirt) must be performed regularly so that the brightness of the lighting is not compromised.

PROBLEM RESOLUTION:

- Poor and/or impaired driver visibility due to blowing snow and dust or low light conditions that impair visual identification of roadway travelways.

USER BENEFIT:

- Traveler security/safety.
- Potential accident reduction.
- More effective use of State Patrol/response team resources,
- High public acceptance.



PROJECT IDENTIFICATION:

SW-4

PROJECT NAME:

Advanced Technology Roadway Delineation

PROJECT RATIONALE:

Many accidents that occur along the I-70 West Corridor can be attributed to the motorists inability to distinguish the travelway at dusk, dawn, and nighttime hours when light levels are poor and during rain, sleet, snow, and fog conditions. Advanced Technology Roadway Delineation offers a relatively cost-effective means to provide delineation of the traveled way during adverse visual conditions. Public acceptance will be favorably high.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Region 1: Identification of number and location of delineation systems desired; equipment procurement and installation; system evaluation; operations and maintenance for systems installed between the Hogback and Vail Pass.

Region 3: Identification of number and location of delineation systems desired; equipment procurement and installation; system evaluation; operations and maintenance for systems installed between Vail and Glenwood Springs.

PRELIMINARY COST ESTIMATE:

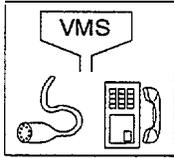
Planning:	\$5,000
Equipment Procurement/Installation (2, 000-foot Section):	
Mono-Directional Lighted Guidance Tube:	\$25 Per Foot
Bi-Directional Lighted Guidance Tube:	\$30 Per Foot
Operations (Power) :	\$5,000 Per Annum Per Installation
Maintenance:	\$1,000 Per Annum Per Installation
Per Site Total (2,000-Foot Section, Excluding Operations/maintenance):	\$55,000 - \$65,000

(Note Maintenance generally involves replacement of a 20-foot section following an impact or other disturbance that crushes or breaks the tubing, as well as routine cleaning of the exterior of the tube.)

Evaluation: \$10,000

IMPLEMENTATION PLAN:

Identification of Delineation Locations:	March 1996 - June 1996
Procurement and Installation:	July 1996 - August 1996
Evaluation:	September 1996 - August 1997

**PROJECT IDENTIFICATION:**

cs-9

PROJECT NAME:

Hanging Lake TOC Upgrades

PROJECT DESCRIPTION:

This project would provide the Hanging Lake TOC with upgrades to three of its major components: communications, video surveillance and call boxes.

Communications will be improved with the installation of 17 miles of fiber optic cable between the Hanging Lake TOC and Glenwood Springs. Fiber optic communications is currently the most reliable high-transmission form of bounded communications. This fiber optic backbone would serve as the communications link for the VMS located in Glenwood Springs, as well as the VMS and video cameras along I-70. With a large bandwidth, the fiber optic backbone would provide reliable communication links for all ITS additions to the corridor. Early Action Project CS-2, High-Capacity Data Transmission Links, expands this 17 mile fiber optic communications link to the entire I-70 West Corridor.

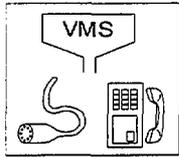
Fiber optic cable is expensive to install and maintain. CDOT is faced with two feasible alternatives to address funding sources. The first is to rely on private industry to install the cable and lease the necessary bandwidth from them. The second is to install the cable, absorbing the high initial cost, with excess bandwidth than anticipated under full ITS deployment. This would be accomplished at a minimal additional cost. The additional bandwidth would be leased to other users. The additional income from the lease would be used to recover the initial investment and fund future ITS projects in the corridor. Further discussion of fiber optic communications is discussed in Early Action Project CS-2, High-Capacity Data Transmission Links.

Color cameras with zoom capability would be installed in place of and/or to supplement existing cameras. The color cameras would be connected to the Hanging Lake TOC via the new fiber optic cable, where applicable, and via leased lines when fiber is not available. The cameras would be able to perform traffic counting functions and monitor traffic patterns for possible automatic incident detection. Color cameras would also allow for identification of hazardous material vehicles and other vehicles identified by law enforcement agencies. These vehicles would be monitored, by consecutive camera locations, as they traveled through Glenwood Canyon and the Hanging Lake Tunnel.

Call boxes would be installed at regular intervals (every 1/2-mile in high-incident locations; every mile elsewhere) throughout the I-70 West Corridor between Glenwood Springs and the Garfield/Eagle County line. These call boxes would consist of two-way solar powered cellular phones. The call boxes would allow motorists involved in an accident or experiencing vehicular failure to contact the Hanging Lake TOC. In turn the Hanging Lake TOC would dispatch the proper emergency vehicles to the scene. This project would be enhanced by Early Action Project ER-3, Corridor-Wide Call Box System, expanding the location of road-side call boxes to the entire I-70 West Corridor.

PROBLEM RESOLUTION:

- Communications between Hanging Lake TOC and Glenwood Springs is insufficient for future ITS needs.
- Existing black/white cameras cannot identify hazardous material vehicles.



PROJECT IDENTIFICATION:

cs-9

PROJECT NAME:

Hanging Lake TOC Upgrades

- Inadequate and inaccurate knowledge of incidents as they occur.
- Inability of traveling motorists to get help or communicate problems.

USER BENEFIT:

- Reliable high-capacity data transmission between the Hanging Lake TOC and Glenwood Springs.
- Connectivity for future systems.
- Digital, video, and analog data conveyance.
- Incident confirmation through video surveillance and call box responses.
- Faster clearing of travel lanes to reduce congestion impacts by incidents.
- Positive ID of hazardous material vehicles.
- Traveler security.
- Technologically-updated TOC .

PROJECT RATIONALE:

Data-intensive ITS applications require accurate and reliable communication links to transmit and receive information. As ITS projects develop along the I-70 West Corridor, fiber optic communications will prove to be an integral part of implementation. A fiber optic cable between the Hanging Lake TOC and Glenwood Springs would allow for future ITS project to achieve proper communications throughout this region.

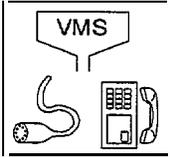
Cameras, providing traffic surveillance of I-70 throughout Glenwood Canyon, would serve as traffic counters and can potentially aid in the timely detection of traffic incidents. Additionally, identifying hazardous material vehicles, especially in the area of the Hanging Lake Tunnel, is critical in maintaining traffic safety in this area. Color cameras would be able to detect the warning placards on these vehicles.

Motorists stranded on I-70 currently must rely on passer-byers to assist them in times of trouble or need. The presence of call boxes at regular intervals would allow those motorists involved in an accident to contact the Hanging Lake TOC and request help. Detection and response time to such cases would be greatly decreased while traveler security and safety would be increased. Existing Glenwood Canyon call boxes provide only one-way communications, resulting in motorist insecurity as to whether their call is being answered.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Region 3: Program funding, planning, design, integration, equipment installation, evaluation and maintenance.



PROJECT IDENTIFICATION:

cs-9

PROJECT NAME:

Hanging Lake TOC Upgrades



PRELIMINARY COST ESTIMATE:

Fiber-Optic Cable (17 miles @ \$45/ft.):	\$4,040,000
Cameras, Color, Pan, Tilt and Zoom (10 @ \$5,000):	\$50,000
Call Boxes, Cellular (37 @ \$3,500):	\$130,000
Testing/Evaluation:	\$25,000
Maintenance:	\$30,000 Per Annum
Lease of Fiber Line:	(to be negotiated w/utility)
Total	\$4,245,000

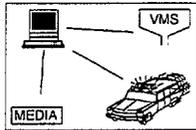
Approximate Cost-Sharing Arrangement:

Colorado Department of Transportation, Region 3: \$4,115,000

Other: \$130,000

IMPLEMENTATION PLAN:

Planning/Design:	January 1996 - August 1996
Procurement:	September 1996 - December 1996
Installation:	January 1997 - June 1997
Testing/Evaluation:	July 1997 - December 1997

**PROJECT IDENTIFICATION:**

SW-8

PROJECT NAME:

Emergency Response Information System

PROJECT DESCRIPTION:

Emergency situations occurring on I-70 are often compounded by motorists who, unaware of the emergency conditions ahead, continue to travel the corridor. The Emergency Response Information System would broadcast incident information to motorists traveling the corridor. When not precluded by an emergency, the system would broadcast travel delays associated with recurring congestion.

The project would call for the construction of two VMS at Dowd Junction, six at Vail, and four at SH 82. Additional small roadside VMS (approximately 35) would be installed region-wide to inform drivers of roadway conditions ahead. The signs at SH 82 can be partially funded by the CDOT Region 3 Operations/Maintenance Division.

Emergency information, pertaining to roadway incidents, adverse weather, avalanches, or other catastrophes (collected at the Denver Metro and Eisenhower TOCs, and other sensed locations) would be transmitted to the Hanging Lake TOC and fused with the Hanging Lake emergency information. By processing the information centrally, all data would be subjected to the same criteria to determine appropriate predetermined message content and VMS location for message broadcast. Some emergencies may necessitate a variety of predetermined messages, of differing intensity, for multiple VMS along the corridor.

Information regarding travel delays from recurring congestion would also be broadcast. Travel delays for the entire corridor would be processed centrally by the Hanging Lake TOC. Travel delay reports would be fused and processed to determine travel delays for the entire corridor. Predetermined messages relating this information would be sent out to the system of VMS to alert motorists of delays.

The signs and TOCs would be connected by leased telephone lines until a fiber optic network is in-place to handle I-70 ITS needs. The VMS could additionally broadcast road/weather conditions as developed under Early Action Project DCA-7, Advanced Ice Detection Warning System.

PROBLEM RESOLUTION:

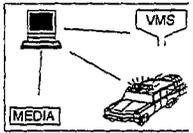
- Motorists not aware of emergency conditions ahead.

USER BENEFIT:

- Traveler awareness/security/safety.
- High public acceptance.

PROJECT RATIONALE:

When emergency events occur it is paramount to make the public aware as soon as possible. Many sections of the I-70 West Corridor do not have alternate routes. Early knowledge of emergency events occurring ahead will allow motorists to avoid completely or at the least be prepared for delays.



PROJECT IDENTIFICATION:

SW-8

PROJECT NAME:

Emergency Response Information System

The VMS Early Response System proposed by this project would become an important tool in advising corridor motorists of emergencies. Additionally, when no emergencies are present, the system would be utilized to broadcast travel delays as a public service.

This project would set up a working system of VMS which could be utilized and expanded by a variety of future ITS projects.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Program funding, planning, design, procurement, equipment installation, testing, and evaluation.

PRELIMINARY COST ESTIMATE:

VMS:	\$1,200,000
Software Development:	\$50,000
Processor:	\$5,000
Communication Links:	\$725,000
Evaluation:	\$25,000
Maintenance :	\$30,000 Per Annum
Total:	\$2,005,000

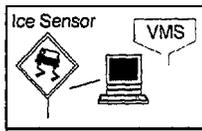
Approximate Cost-Sharing Arrangement:

Colorado Department of Transportation: \$1,805,000

Operations/Maintenance: \$200,000

IMPLEMENTATION PLAN:

Planning/Design:	January 1997 - July 1997
Procurement:	July 1997 - October 1997
Installation:	October 1997 - December 1997
Testing/Evaluation:	December 1997 - March 1998



PROJECT IDENTIFICATION:

DCA-7

PROJECT NAME:

Advanced Ice Detection/Warning System

PROJECT DESCRIPTION:

Pavement sensors would be installed at several locations along the I-70 West Corridor in CDOT Region 3. Mountain pass locations would include Eagle (1 sensor, EB lane only); DeBeque (2 sensors); McClure, Independence (5 sensors); Dowd (2 sensors); and Douglas in the canyon (8 sensors). Information from the sensors would be used to determine problem areas, as defined by lengths of roadway with existing or forming ice patches. These areas would be targeted by road crews for ice removal. This would allow for more efficient use of road crews, equipment, and materials.

Real-time weather data, from the sensors, would be transmitted to a central processor at the Hanging Lake TOC. Information from Surface Sensors Incorporation (SSI), including temperature, would also be received at the central processor where it would be fused together with the pavement sensor data. Centralized aggregation and processing of information would allow for more comprehensive analysis of the data. Expert systems would be developed that would determine the most effective and efficient use of labor, equipment and materials.

The data, both input and output, at the central processor would be made available for dissemination to other corridor TOCs, kiosks and outside agencies, including, but not limited to, information services and local and regional television and radio channels. Real-time road/ice conditions would eventually be sent to existing VMS where they would advise motorists of hazardous road conditions.

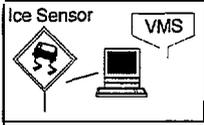
Based on the evaluation and success of this system, it could be implemented in the eastern half (Region 1) of the corridor.

PROBLEM RESOLUTION:

- Icy road conditions create hazardous traveling conditions.
- Incomplete timely knowledge of road/ice conditions.

USER BENEFIT:

- Early detection of icy road conditions.
- Preventive ice clearing procedures.
- Improved and automated maintenance crew response to localized problem areas.
- Dissemination of real-time road/ice conditions to traveling public.
- Traveler security/safety.



PROJECT IDENTIFICATION:

DCA-7

PROJECT NAME:

Advanced Ice Detection/Warning System

PROJECT RATIONALE:

Icy road conditions throughout the I-70 West Corridor create a hazard to motorists traveling the corridor. Pavement sensors would be able to detect ice on the roadway at high risk areas of the corridor. Reliable identification of icy roadways will enable road crews to perform their duties more efficiently. Less hazardous roads will increase the flow and safety of traffic.

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Regions 1, 3, and 6: Program funding, planning, design, installation of equipment, testing, and evaluation.

Private Information Providers: Financial support for purchase of equipment.

PRELIMINARY COST ESTIMATE:

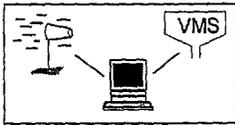
Pavement Sensors:	\$285,000
Software Development:	\$25,000
Processor:	\$5,000
Communication Links (w/pavement sensors and SSI):	\$200,000
Evaluation:	\$25,000
Maintenance:	\$30,000 Per Annum
Total:	\$540,000

Approximate Cost-Sharing Arrangement:

Colorado Department of Transportation: **\$540,000**

IMPLEMENTATION PLAN:

Planning/Design:	January 1997 - March 1997
Procurement:	April 1997 - July 1997
Installation:	July 1997 - December 1997
Testing/Evaluation:	December 1997 - May 1998



PROJECT IDENTIFICATION:

TIS-1

PROJECT NAME:

Georgetown Gustly Wind Sensor/VMS System

PARTICIPATING ORGANIZATIONS/RESPONSIBILITIES:

Colorado Department of Transportation:

Region 1: Program funding, planning, design, integration, installation, evaluation and maintenance.

Private Commercial Vehicle Operators: Financial support for purchase of equipment.

PRELIMINARY COST ESTIMATE:

Wind Sensors:	\$40,000
Software Development:	\$25,000
Processor (<i>at Eisenhower Tunnel TOC</i>):	\$5,000
VMS System:	\$300,000
Communication Links:	\$5,000
Evaluation:	\$25,000
Maintenance:	\$30,000 Per Annum
Total:	\$400,000

Approximate Cost-Sharing Arrangement:

Colorado Department of Transportation: **\$300,000**

Private Commercial Vehicle Operators: **\$100,000**

IMPLEMENTATION PLAN:

Planning/Design:	January 1997 - July 1997
Procurement:	August 1997 - September 1997
Installation:	September 1997 - December 1997
Testing/Evaluation:	December 1997 - February 1998